Tunable Antennas Usıng MEMS Switches For LTE Mobile Terminals

Abstract- Two antenna designs, using MEMS switches for operating band reconfigurability are presented in this paper. The study has been carried out in the scope of ARTEMOS project, whose main target is to propose tunable architectures for future mobile terminals. For this purpose, two antenna designs to cover 700-960MHz and 1.7-2.7GHz are proposed. The switching between low-band (700-960MHz) and high-band (1.7-2.7GHz) is achieved by using MEMS switches. The first design consists of a driven monopole which is capacitively coupled to a parasitic strip, whose input impedance is changed by using a two-branch matching network and the branch selection is done using two MEMS switches. The second design uses two driven strips, one of which is capacitively coupled to a parasitic strip. By choosing between the driven strips with a single MEMS switch, operating band tunability is achieved between low-band and high-band.

Brief Notes

In this study, two antenna designs that use MEMS switches to achieve band-switching between the low-band (700-960MHz) and high-band (1.7-2.7GHz) of LTE communication standard has been proposed.

The MEMS switches have been designed by the project partner DELFMEMS, in scope of the ARTEMOS project. The switches are controlled in a forced ON/forced OFF manner, to achieve good contact in ON state and good isolation in OFF state. The insertion loss and isolation level of the switches in ON/OFF states respectively, can be observed in the "MEMS Switches" section of the poster.

The first antenna design proposed consists of a driven strip which capacitively excites a parasitic strip connected to the ground plane. An inductor is used at the ground connection point, to increase the electrical length of the strip. The parasitic strip creates a resonance around 760MHz, which increases the bandwidth potential in the low-band. A matching network which consists of two branches is introduced at the antenna feed and these branches are separated using two MEMS switches. The antenna is then matched either in the low-band (700-960MHz) or in the high-band (1.7-2.7GHz), selecting one of the two MN branches using MEMS switches.

In the second antenna design there are two driven strips, one of which capacitively excites a parasitic strip connected to ground plane. In this topology, the number of MEMS switches is reduced to only one, and it is used to excite either the low-band driven strip or the high-band driven strip. The parasitic strip is exploited especially in the low-band to increase the bandwidth potential. By this way, the antenna can be matched either in the low-band through exciting LB driven strip or in the high-band through exciting HB driven strip.

Some difficulties have been faced in terms of reliability due to absence of encapsulation in the switches. To validate the simulation results, measurements were carried out with passive prototypes. A good agreement was seen between simulations and measurements in terms of input impedance. The total efficiency measurements of the prototypes were also carried out in a Satimo Starlab station.

As a conclusion, it was validated through measurements that the target LTE frequency bands could be covered with a band-switching topology, with a reasonable total efficiency. The two antennas proposed show similar performance in terms of matching and efficiency, with the second antenna using one less MEMS switch.

Tunable Antennas Using MEMS Switches for LTE Mobile Terminals

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Abstract

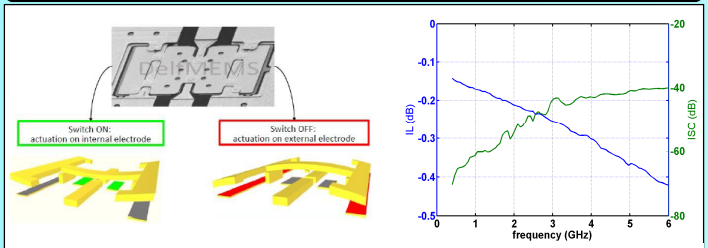
- LTE-bands coverage is difficult with a passive mobile phone antenna

⇨ Two different tunable LTE antennas with MEMS switches are designed

- First approach: 2 SPDT MEMS select one of the two matching branches
- Second approach: 1 SPDT MEMS select one of the two radiating strips

⇨ **Band-switching is obtained to select either the low-band (700-960MHz) or high-band (1.7-2.7GHz) using the MEMS switches**

MEMS Switches

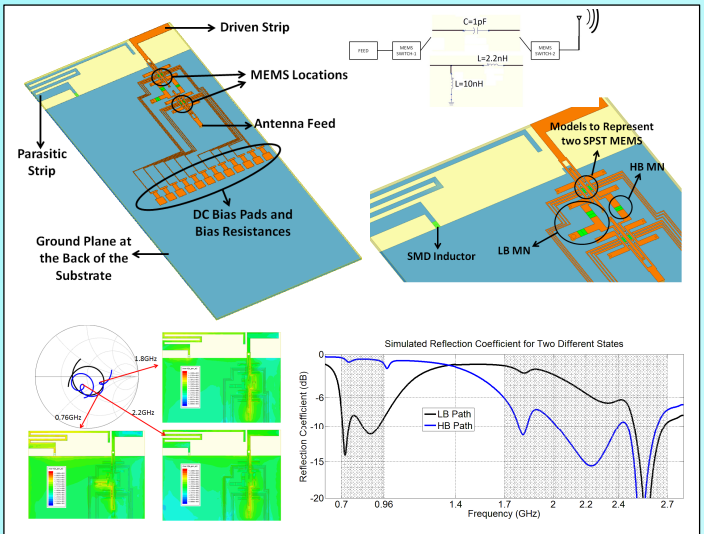


- Designed and manufactured by DELFMEMS within the ARTEMOS project

⇨ Forced ON state to ensure better contact and thus lower insertion loss

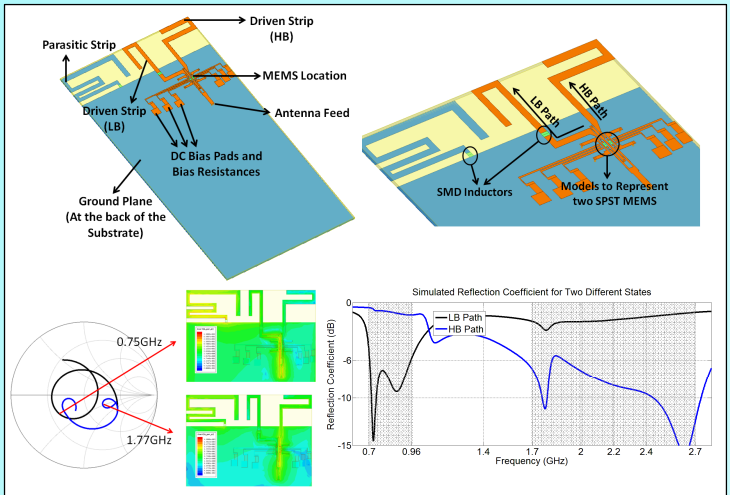
⇨Forced OFF state to ensure better isolation

Antenna-Design-I



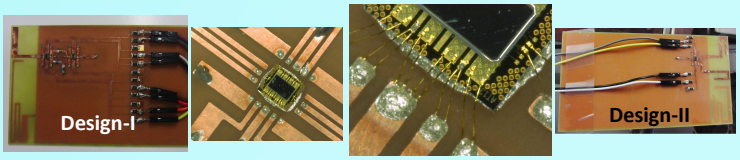
- Select one of the 2 matching branches according the state of the MEMS
- The parasitic strip resonates around 760MHz, helping in the coverage of the 700-960MHz band
- The driven strip is mainly responsible for the HB coverage with additional higher-order resonances of the parasitic strip

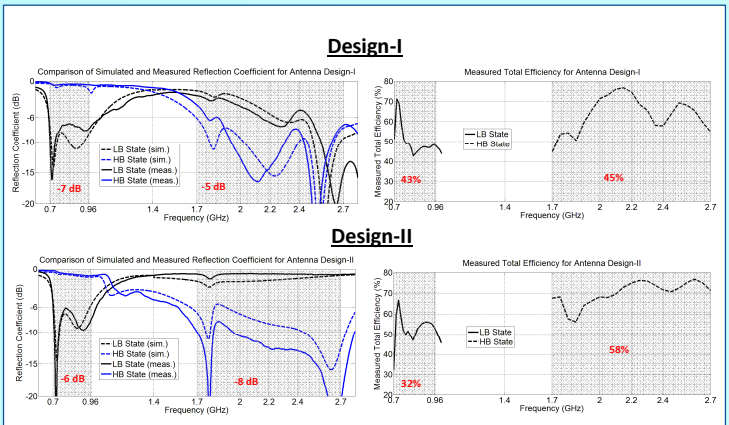
Antenna Design-II



- One of the two driven strips is selected using a single MEMS switch
- LB driven strip capacitively excites the parasitic strip to enable LB coverage

Measurement Results





- Difficulty for measurement with MEMS switches (reliability issue due to absence of encapsulation -> To be solved in next run)

⇨Fair agreement observed between simulation and measurement

- Average worst matching level is -6 dB
- Average worst total efficiency measurements is 45% (Satimo Starlab)

CONCLUSION

- Two antenna designs were proposed, achieving band-switching between low-band (700-960MHz) and high-band (1.7-2.7GHz) of the 4G LTE standard
- Measurements are in fair agreement with simulations
- Target bands are covered with a reflection coefficient below -6dB and an average worst total efficiency of 45%
- The two adopted strategies show similar performance in terms of reflection coefficient and efficiency, whereas design-II uses one less MEMS switch.

ARTEMOS Project

Agile **R**F **T**ransceivers and Front-**E**nds for Future Smart **M**ulti-Standard **CO**mmunications Application**S**